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Agricultural Memorandum 877

Reproductive Failure in Pigs: The Autumn Abortion Syndrome

Introduction

'The Autumn Abortion Syndrome'

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(b) Stress induced abortions.

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Introduction

The Meteorological Office was asked to participate in a joint project with the Ministry of Agriculture, Fisheries and Food (Central Veterinary Laboratory, Weybridge), under the direction of Dr A E Wrathall. This project was set up to investigate the 'Autumn Abortion Syndrome' which is a reproductive failure in pigs.

This report attempts to discuss the autumn abortion syndrome, define the meteorological aspects which may lead to the abortions and present the initial results from the first season of the experiment.

'The Autumn Abortion Syndrome'

"Although in the past the domestic pig has always been considered capable of breeding regularly throughout the year, evidence is now accumulating which suggests that seasonal deficits in reproductive performance do sometimes occur, especially in the late summer and autumn. Such deficits could be of considerable economic significance and a figure of £5-10 million has been suggested for the annual shortfall in pig slaughterings, which may result from seasonal reproductive failures in Britain (Stork, 1969: Vet Rec 104 49).

Because of their dramatic nature the most obvious seasonal failures are the autumn abortions; when fully investigated on the affected farms however, these abortions often turn out to be only the 'tip of the iceberg', being accompanied by cases of anoestrus, delayed puberty and other forms of reproductive failure.

A number of theories have been put forward to explain the autumn abortions (eg climatic stress, underfeeding, endotoxaemia, new barley, microbial infection) but one of the more plausible suggestions is that in the domestic pig, or at least in certain genetic lines or strains, there may be a vestige of the

photoperiodic rhythm seen in the European wild pig, the latter being sexually inactive from July to October. If this suggestion is correct it seems that autumn abortions could be an extreme manifestation of a more general decline in reproductive 'drive'; ie failure, in a proportion of sows, of the endocrine mechanisms which support continuation of pregnancy. It is also conceivable that adverse factors, which at other seasons of the year might be without significant effect, could bring about abortion in the autumn due to weakness of the pregnancy support mechanisms".

This section has been taken from the revised Project Proposal supplied by MAFF Weybridge.

Consideration

(a) Stress induced abortions

If the autumn rise in abortions can be induced by environmental conditions three time scales could be involved. Firstly, sudden changes over a period of a few hours in the sow's environment may be sufficient to cause problems. Secondly, the average environmental conditions over a period of days or a month may be the trigger for the abortions ie if the temperatures are much warmer or colder than the sow requires at that time of the year. Finally, the time scale may be of the order of months and then only indirectly related to the problem. If, over this long period of time, the environment has particularly favoured or hindered the sow's energy balance it may or maynot be fitted to withstand an unfavourable breeding period.

Therefore, time scales ranging from a few hours up to a few months may well be involved in any study on environmental produced stress.

(b) The reproductive failure

Physical abortions have been recorded at any time after the first few weeks of pregnancy up until farrowing. Prior to this period the same reproductive failure may occur but rather than abort the sow may reabsorb the foetus. The farmer only becomes aware of this when the sow returns to oestrus or when one of the other pregnancy checks proves negative or at farrowing when the sow is shown not to be in pig. As most pig farms have less than 100% service success, typically 60-90%, any failure in the reproductive mechanism related to the time of the year is recorded as a poor service and the sow is reserved.

The veterinary evidence indicates that up until the time of physical abortion the service and pregnancy is perfectly normal. It has been demonstrated that at temperatures greater than 30°C or during periods of rapid change of temperature around 25°C the boar loses its sexual drive and fertility. Even though these conditions are sometimes reached in Great Britain, for example in the hot dry summer of 1976, there is no evidence for a rise in the number of physical abortions in the period following a successful service at this temperature. Therefore, if the abortions are triggered by a period of stress it is most probable that these are caused by the short term fluctuations in the sow's environment during the main part of pregnancy and the magnitude of these may be modified by the condition of the sow, perhaps caused by a period of stress, in the days or months leading up to the service period.

Past years' abortion data

During the course of the project, described in the following section, several of the herd owners or managers made their past records available and these are presented to give some idea of the number of the abortions on individual farms. The seasonal and yearly variation can be seen by examining

figures 1 and 2 and the particularly meticulous records kept by Taylor May Farm, figure 3, allow a far more detailed look to be taken at the day-to-day fluctuations in the numbers of abortions.

The project

A project under the control of the Ministry of Agriculture, Fisheries and Food was set up to investigate the 'Autumn Abortion Syndrome'. The project, scheduled to last for at least one year, involves the cooperation of pathologists, biochemists, bacteriologists, virologists, epidemiologists, veterinary staff and meteorologists. The meteorological objective is: (1) to ascertain if any evidence of the photoperiodic rhythm seen in the European wild pig, can be detected and (2) to see if environmental conditions are responsible for any of the abortions.

Seven farms, six of which have herds of over 200 sows, have agreed to participate in the project and the locations of these are shown in figure 4. Each of the herds, with the exception of Church Farm, Norwich, has a history of autumn abortions. Many measurements are being taken throughout this period and including blood samples, physical condition of the sows and the examination of any aborted litter. The temperature is recorded in each of the sow houses, as close to the sows as is practically possible. Each farm was also examined for exposure and a few spot measurements of light levels were taken.

Each herd is unique in respect to housing and management. The buildings ranged from modern purpose-built units, where the sows are housed for the whole of their life, to the more traditional type where they have the freedom to move inside or outside as they wish.

1979 data analysis

The abortion data for the seven herds are shown in figure 5. Figure 6 shows Taylor May Farm data in a little more detail.

The sow house temperatures for the period up until the end of December were analysed at two-hour intervals and these data were converted into a computer-accessible form. Some typical temperature traces, prior to analysis, are shown in figures 7 and 8. The data from Taylor May Farm, the farm with the worst abortion record in the study, demonstrate that the sows were being kept at almost ideal temperatures, (the ideal environmental temperature to maintain an efficient heat balance is + 17°C), even during the end of November and early December. Church Farm data demonstrates the temperature changes that are experienced inside the house when the sows go outside to be fed at 0800 every morning. Exeter data demonstrates firstly that temperatures in close proximity to the sow can on occasions go below 0°C and secondly the scale of the temperature changes that a semi-outdoor herd experiences.

For each of the farms outside temperatures, air pressures and days with thunder were obtained from the nearest Meteorological Office.

The data from all of these sources were collated and correlations between the days when abortions took place and the various parameters were sought. Because of the low number of abortions that were recorded in the 1979 autumn period these correlations are discussed in the following section which deals with all of the available abortion data.

Correlation of abortions with meteorological parameters

If the photoperiodic rhythm, seen in the European wild pig, is responsible for the rise in numbers of autumn abortions it would seem reasonable to find a correlation between the number of abortions and the daylength or perhaps the rate of change in daylength. Figure 9 demonstrates that the autumn abortion period for Taylor May Farm, also for all of the other farms with abortion records, coincides with the maximum change in daylength, possibly confirming the

photoperiodic hypothesis. This immediately raises two questions; firstly do the number of abortions increase and take place over a longer period for locations where the rate of change of daylength is greater and secondly do the observed changes in level of abortions from one year to another arise because of the daily and yearly variation in radiation levels that occur?

Figure 10 shows the change in daylength for the southernmost and northernmost farms in this experiment. It can be seen that further north the change in daylength is more marked and remains larger over a longer period.

It is impossible to ascertain if the latitude has any effect on the abortion problem because of the low number of abortions in the 1979 season and the fact that most of the available abortion data for the past are only available on a monthly basis. It might be very informative if abortion data were available for a pig farming area, eg Aberdeenshire where the change in daylength rises to a value of -0.08 hours per day at its maximum and is large over a long period.

As there appears to be a relationship between the number of abortions and the rate of change in daylength it is possible that the yearly fluctuations in abortions might be caused by variations in radiation levels. Figure 11 gives the daily values of total radiation from a station near to Taylor May Farm. No obvious correlation can be found from these data.

One final point with regard to daylength and light levels is that if the animals respond to actual light levels, rather than being sensitive to general change in daylength by some internal biological clock, the abortion numbers should be lower in herds which are subject to constant light levels. The evidence from Taylor May Farm which has two identical units, with the exception that one unit has continual artificial illumination as well as

natural lighting, shows no difference in abortion levels.

The internal sow house temperatures, external air temperatures, atmospheric pressures and total radiation levels are shown in figures 12 and 13 for Taylor May Farm for part of the 1979 abortion period. The internal sow house temperatures are for the vast majority of the period at almost ideal temperatures for pigs and these are on average about 8°C warmer than the external air temperatures.

Taking all of the available data into account there appears to be no correlation between the number of abortions and maximum, minimum, average and daily change in sow house temperature or maximum, minimum, average and daily change in external air temperature or maximum, minimum, average and daily change in atmospheric pressure. One further meteorological phenomenon which could possibly induce abortions, the occurrence of thunder, was investigated and again no correlation was found.

It has been suggested in a previous section that the condition of the sow is influenced by the environmental conditions that were present in the days or weeks prior to the abortion period and this may account for the yearly variation in abortion numbers. Figure 14 shows the monthly values of some of the major meteorological parameters, from Writtle, which are applicable to Taylor May Farm. Once again no correlation can be found to explain the difference in abortion numbers between 1977 and 1978.

Summary

The reproductive failure in pigs, the 'Autumn Abortion Syndrome' has been discussed and studied using past years data and current data taken during the joint project with the Ministry of Agriculture Fisheries and Food.

The evidence suggests that the performance of the sow is affected by the change in daylength which supports the hypothesis posed in the project proposal "that in the domestic pig or at least certain genetic lines or strains there may be a vestige of the photoperiodic rhythm seen in the European wild pig". No other correlation has been found for any of the meteorological parameters which can explain the daily, monthly or yearly variation in the abortion levels.

Acknowledgements

The author wishes to thank Dr J Starr for his invaluable comments made during the course of the project and for supplying some of the initial data from the Pig Improvement Co Ltd, Fyfield Wick. Thanks are also expressed to the herd owners or managers who have taken the meteorological measurements and in particular to M Lowe, Taylor May Farm without whose meticulous records much of the analysis would have been impossible to perform.

Any comments or suggestions about this article should be referred to the author.

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March 1980

Figure 1 1977 and 1978 Abortion data

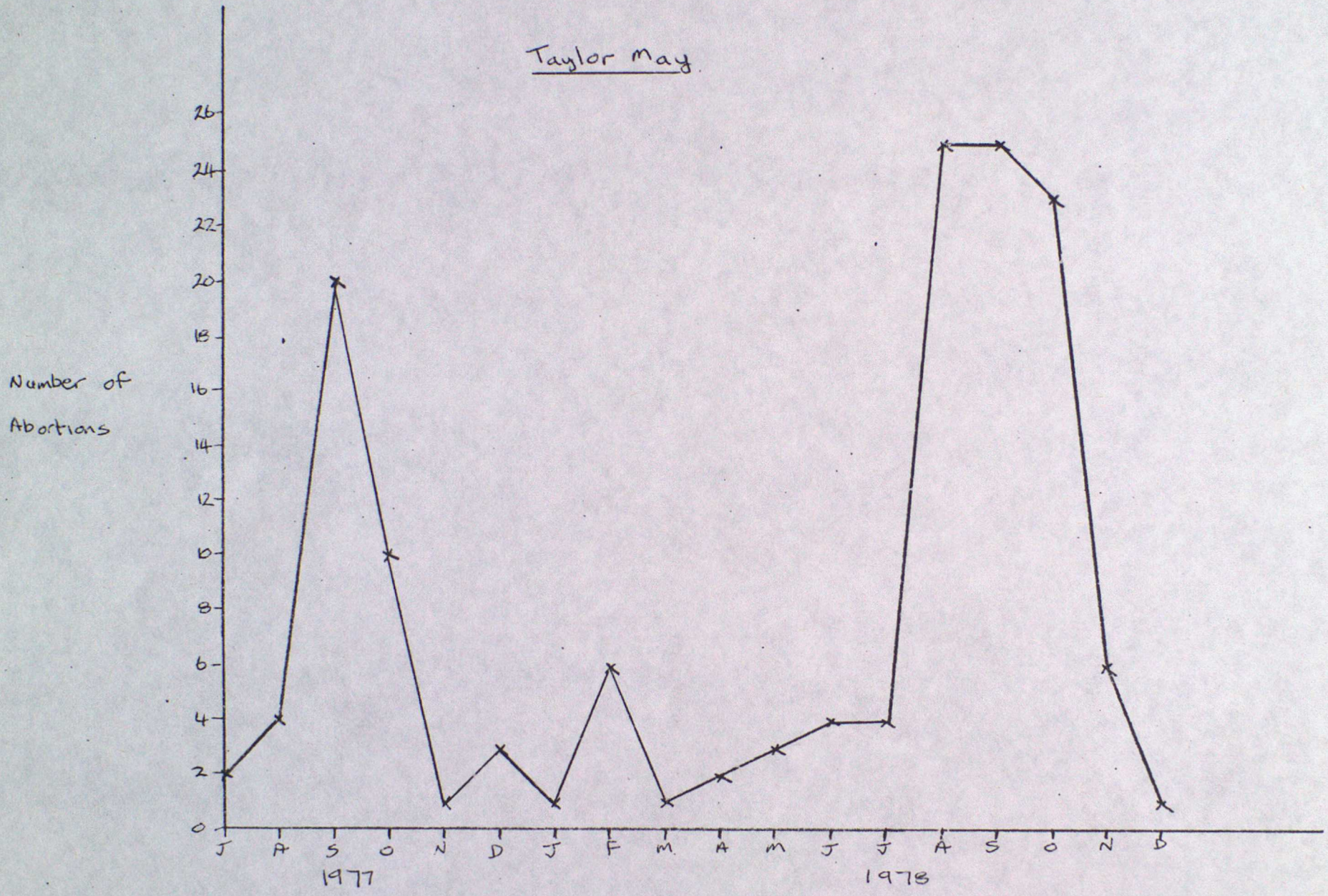
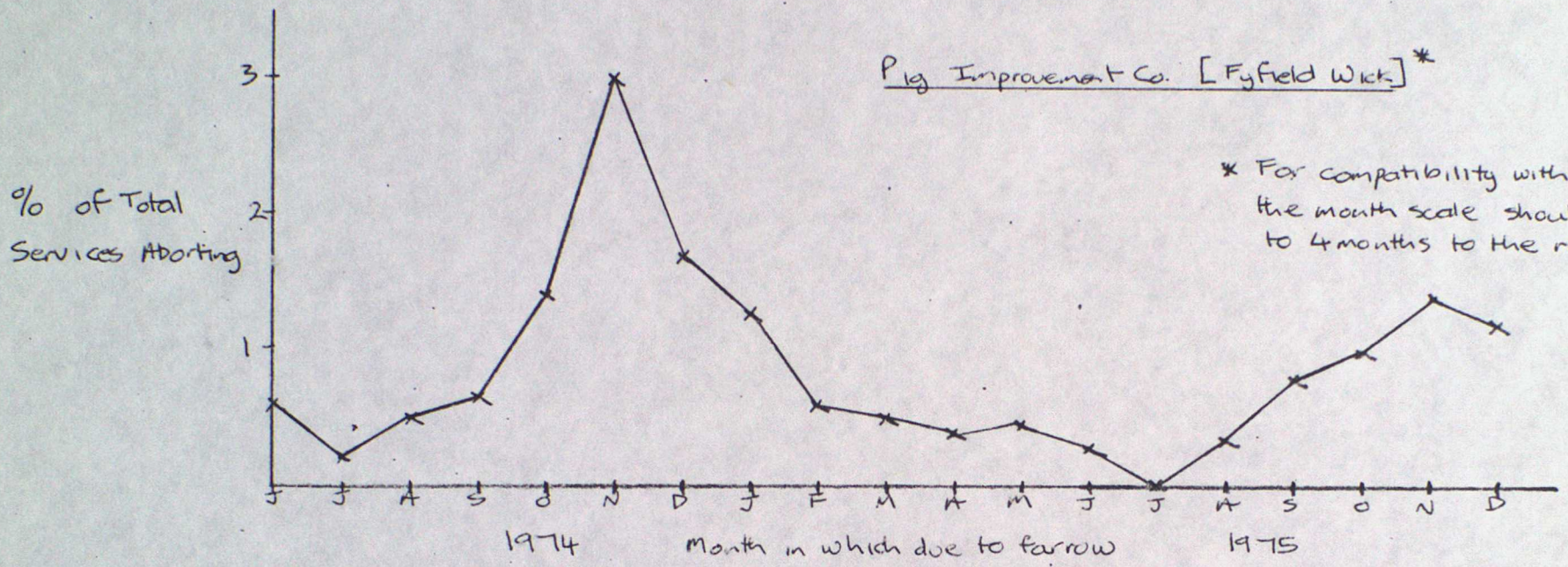


Figure 2 1974 and 1975 Abortion data.


Pig Improvement Co. [Fyfield Wick]*
% of Total Services Aborting
3
2
1
J J A S O N D J F M A M J J A S O N D
1974
Month in which due to farrow
1975

* For compatibility with the other graphs the month scale should be moved by up to 4 months to the right (ie. D = A).

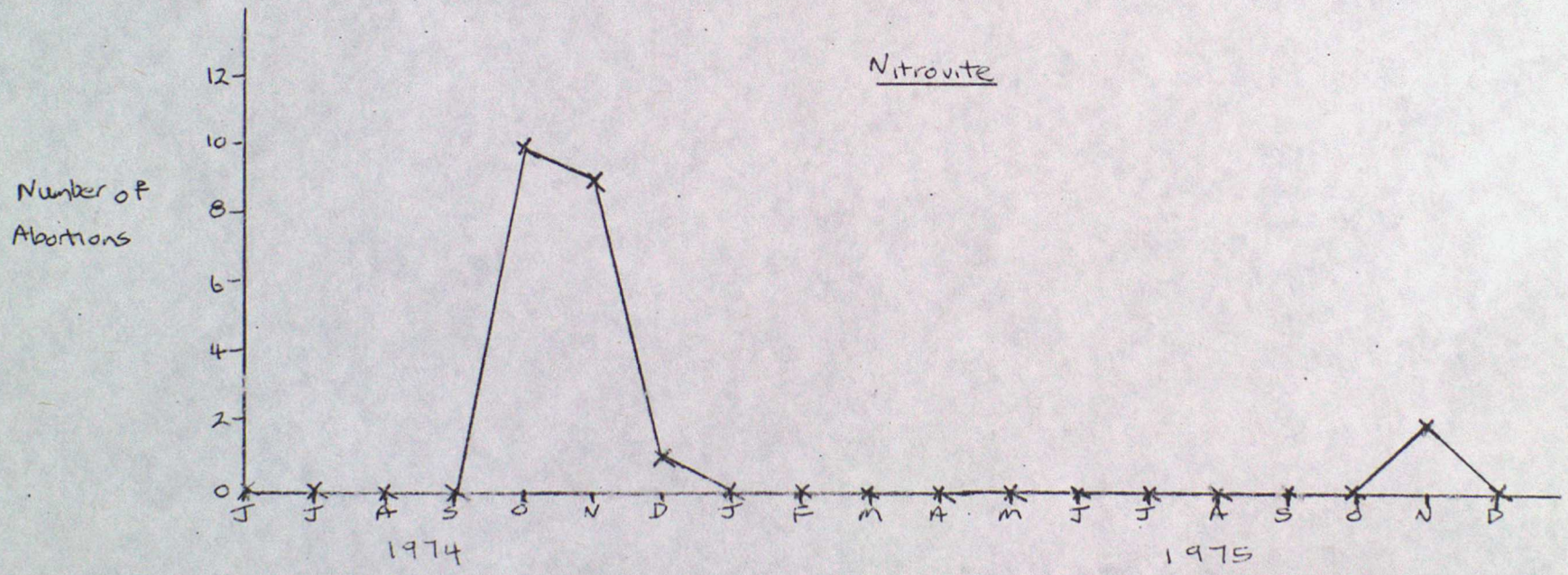
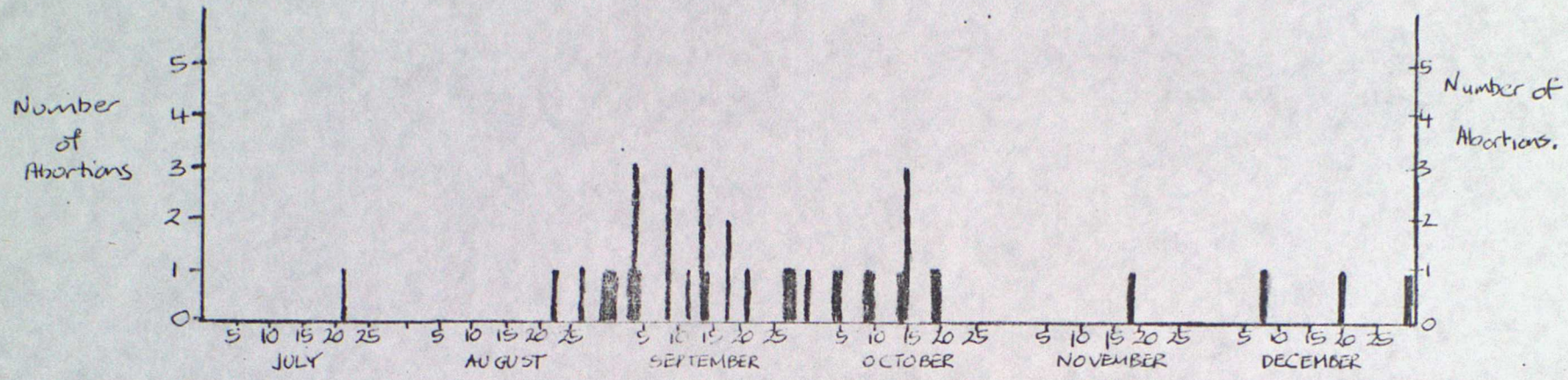
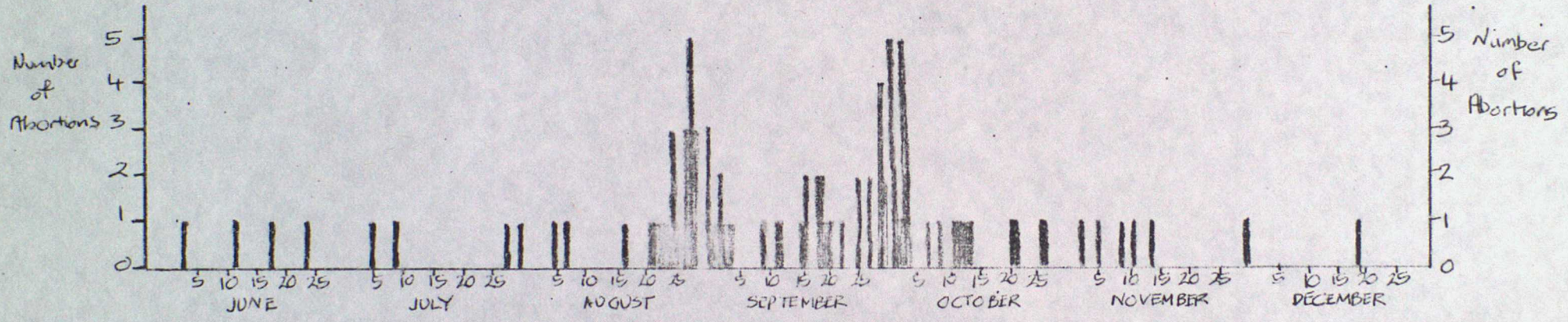


Figure 3. Taylor May Abortion data



1977



1978

Figure 4.

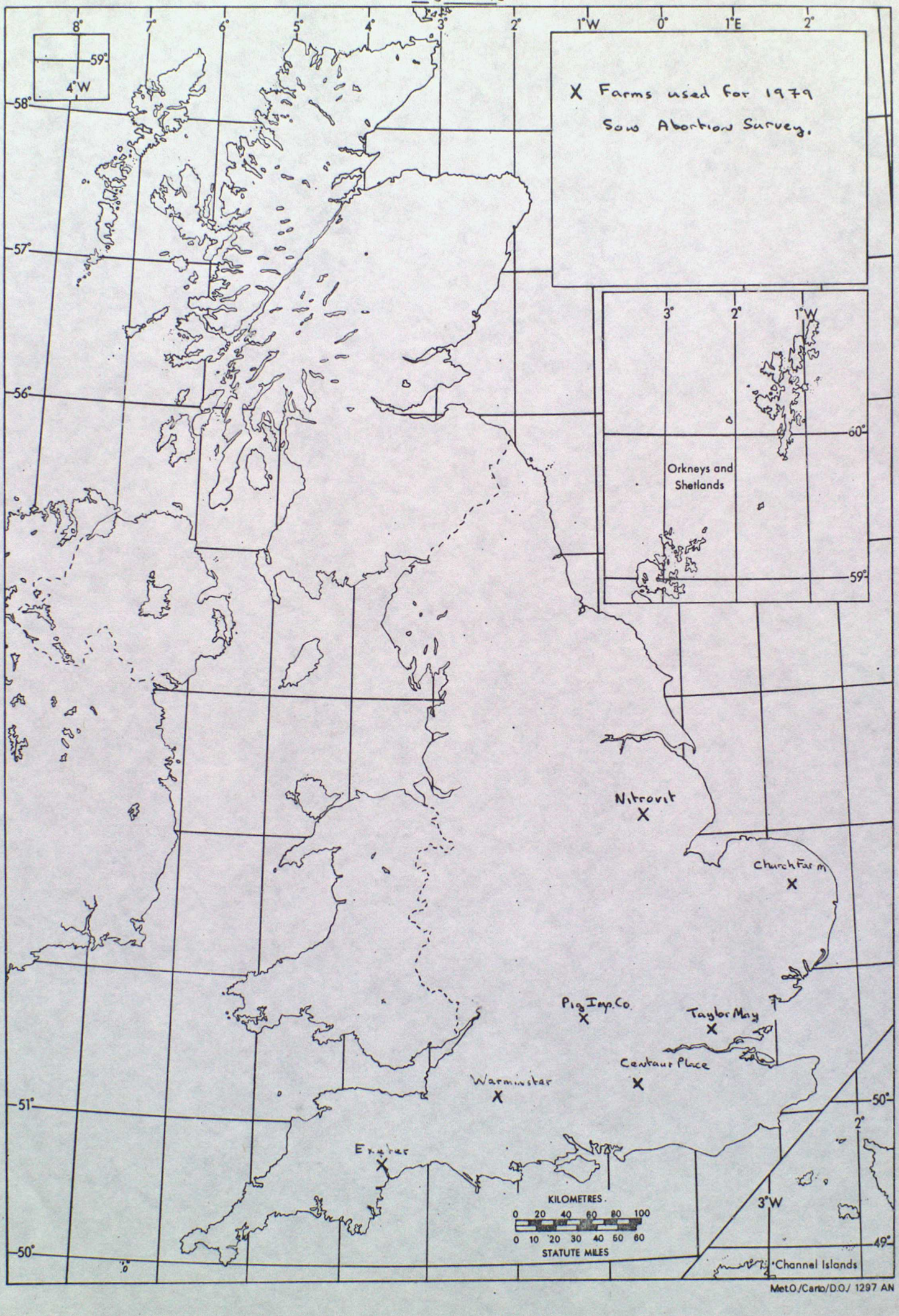
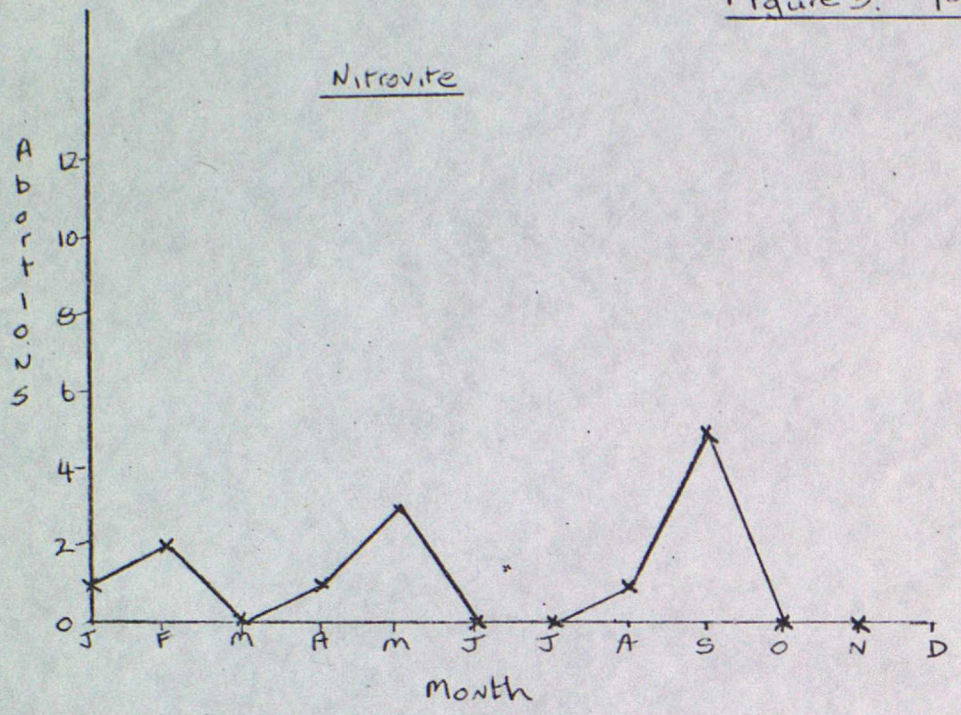
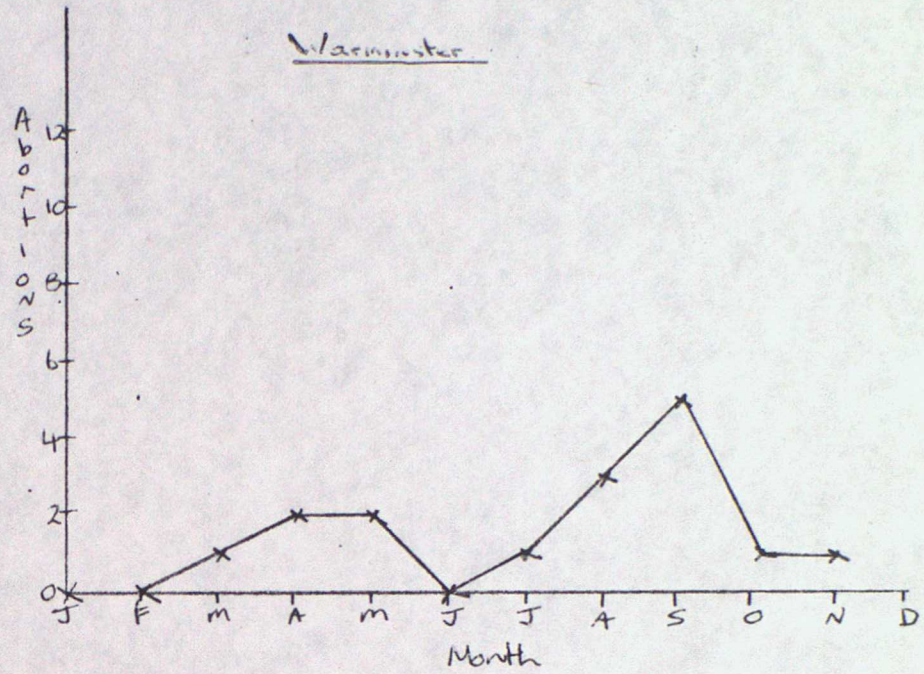
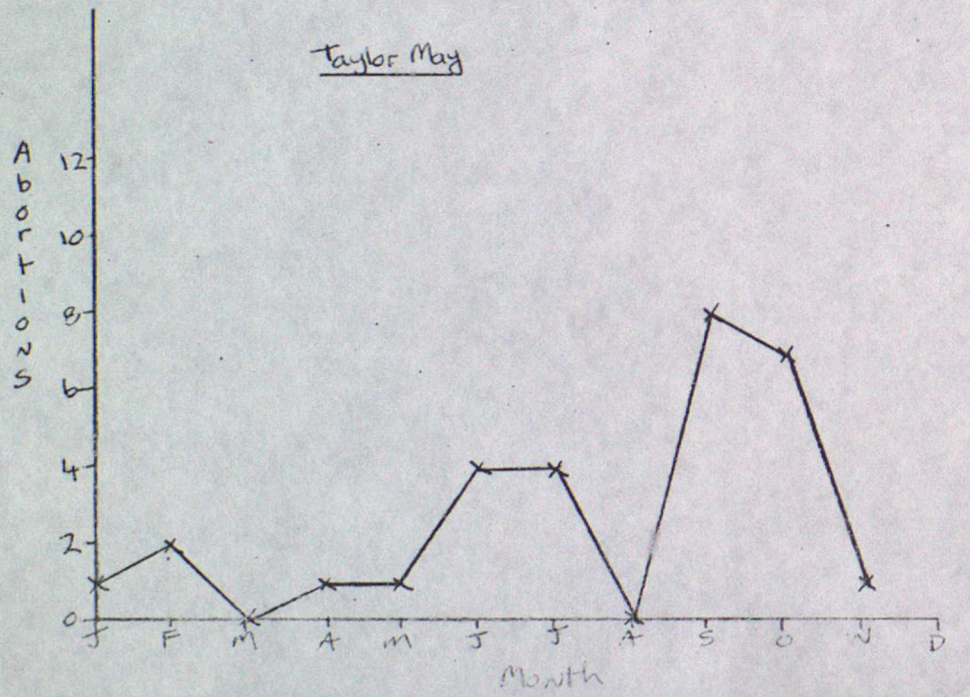

X Farms used for 1979 Sow Abortion Survey.
Orkneys and Shetlands
Nitrovit
Church Farm
Pig Imp. Co.
Taylor May
Centaur Place
Warminstar
Exeter
KILOMETRES
0 20 40 60 80 100
0 10 20 30 40 50 60
STATUTE MILES
Channel Islands
Met.O./Carto/D.O./ 1297 AN

Figure 5. 1979 Abortion data







No abortions were recorded by:-

(1) Exeter
(2) PIC., Fyfield Wick.
(3) Church Farm, Norwich

Figure 6. Taylor May 1979 Abortion Data.

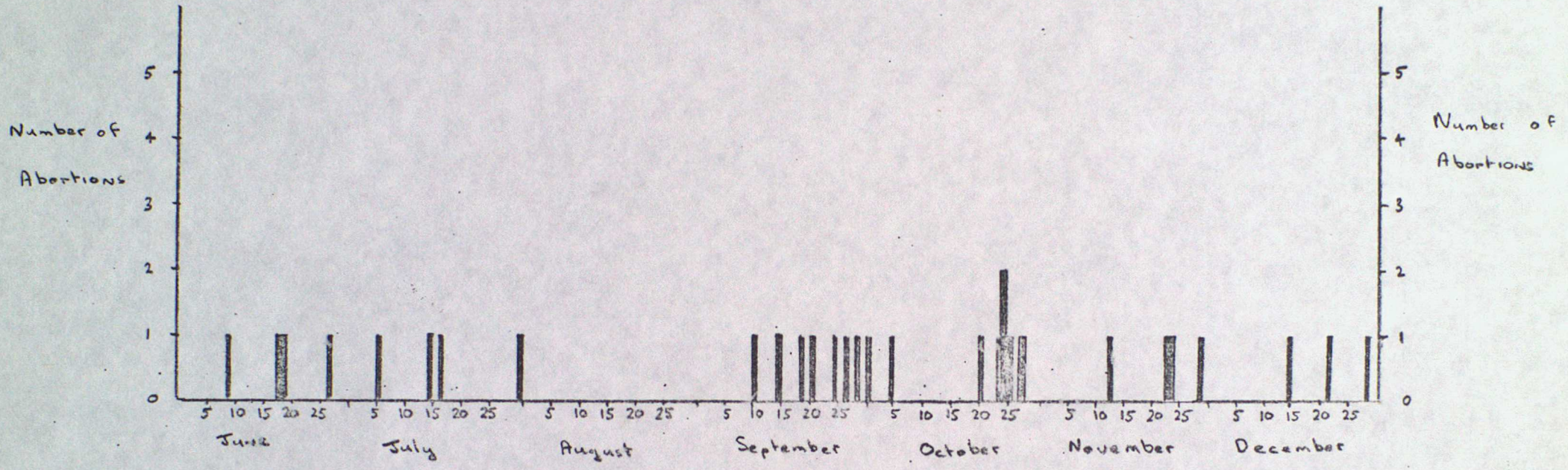


Figure 7 Taylor May Temperature Record.

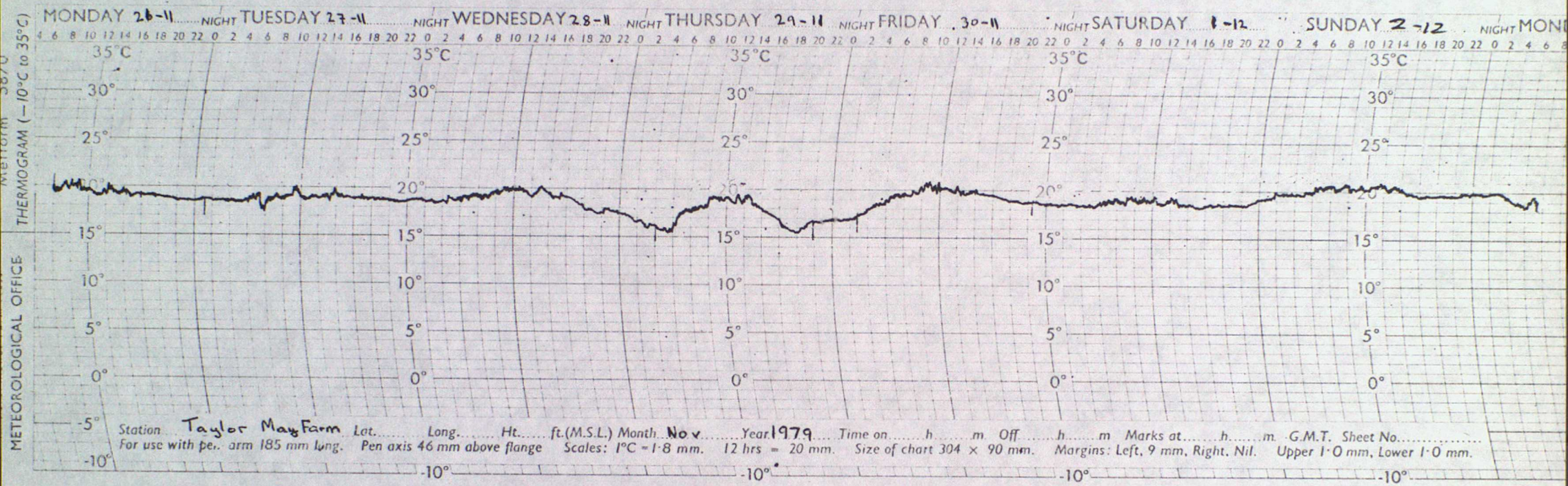
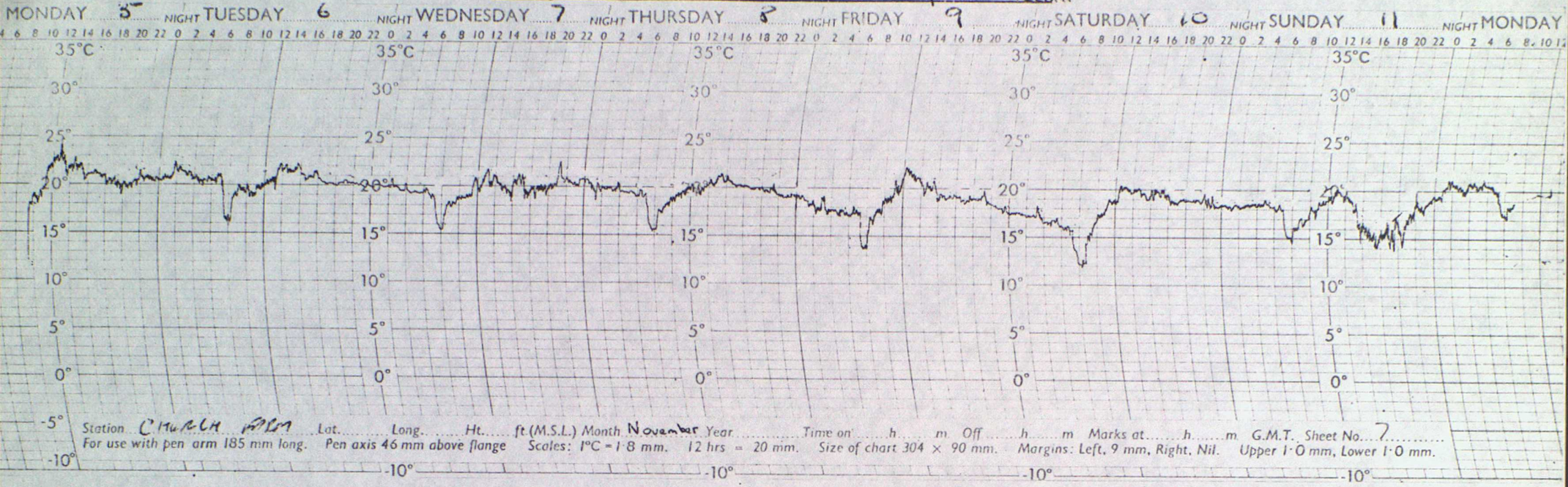

MONDAY 26-11 NIGHT TUESDAY 27-11 NIGHT WEDNESDAY 28-11 NIGHT THURSDAY 29-11 NIGHT FRIDAY 30-11 NIGHT SATURDAY 1-12 SUNDAY 2-12 NIGHT MONI
35°C
30°
25°
20°
15°
10°
5°
0°
-5°
-10°
METEOROLOGICAL OFFICE THERMOGRAM (—10°C to 35°C)
Station Taylor May Farm Lat. Long. Ht. ft.(M.S.L.) Month Nov Year 1979 Time on h m Off h m Marks at h m G.M.T. Sheet No.
For use with pe.. arm 185 mm long. Pen axis 46 mm above flange Scales: 1°C = 1·8 mm. 12 hrs = 20 mm. Size of chart 304 × 90 mm. Margins: Left, 9 mm, Right, Nil. Upper 1·0 mm, Lower 1·0 mm.

Figure 8. Church Farm and Exeter Temperature Record


MONDAY 5 NIGHT TUESDAY 6 NIGHT WEDNESDAY 7 NIGHT THURSDAY 8 NIGHT FRIDAY 9 NIGHT SATURDAY 10 NIGHT SUNDAY 11 NIGHT MONDAY
35°C
30°
25°
20°
15°
10°
5°
0°
-5°
-10°
Station CHURCH FARM Lat. Long. Ht. ft (M.S.L.) Month November Year Time on h m Off h m Marks at h m G.M.T. Sheet No. 7
For use with pen arm 185 mm long. Pen axis 46 mm above flange Scales: 1°C = 1·8 mm. 12 hrs = 20 mm. Size of chart 304 × 90 mm. Margins: Left, 9 mm, Right, Nil. Upper 1·0 mm, Lower 1·0 mm.

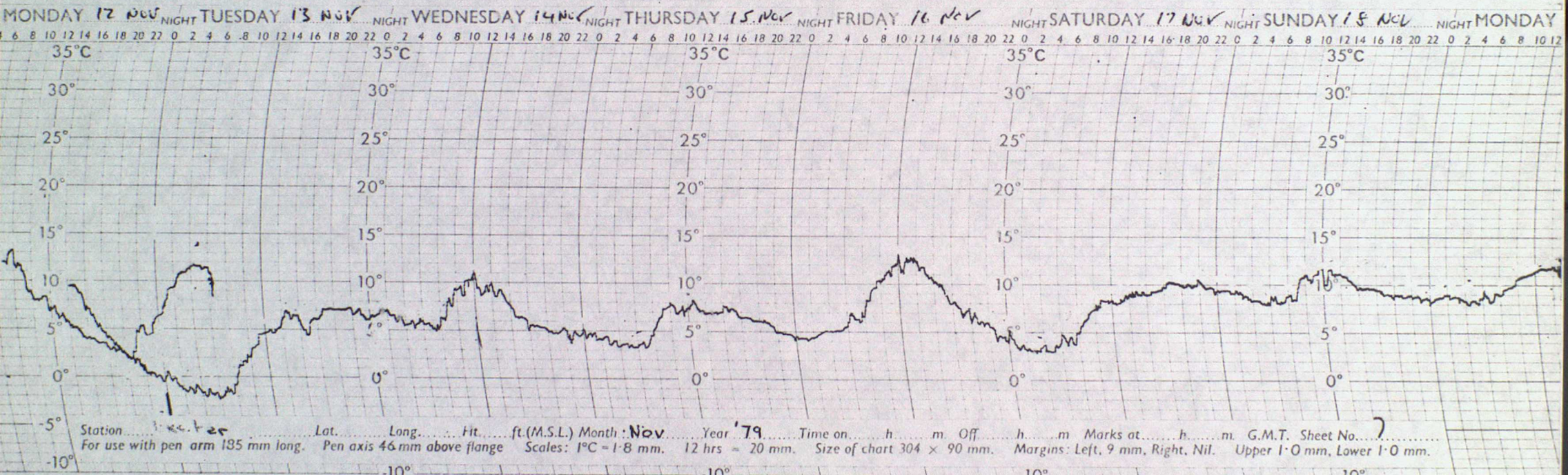
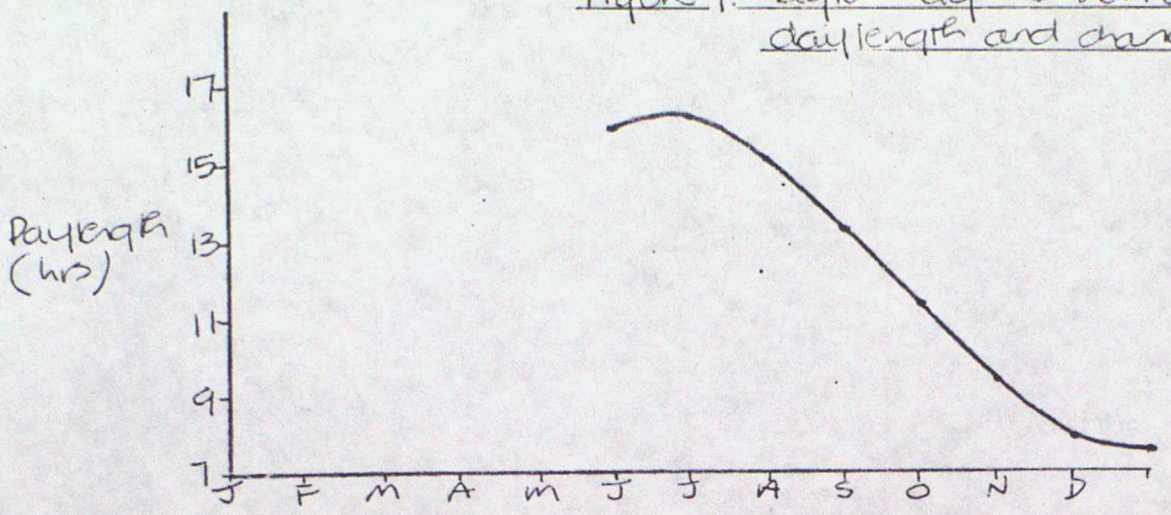
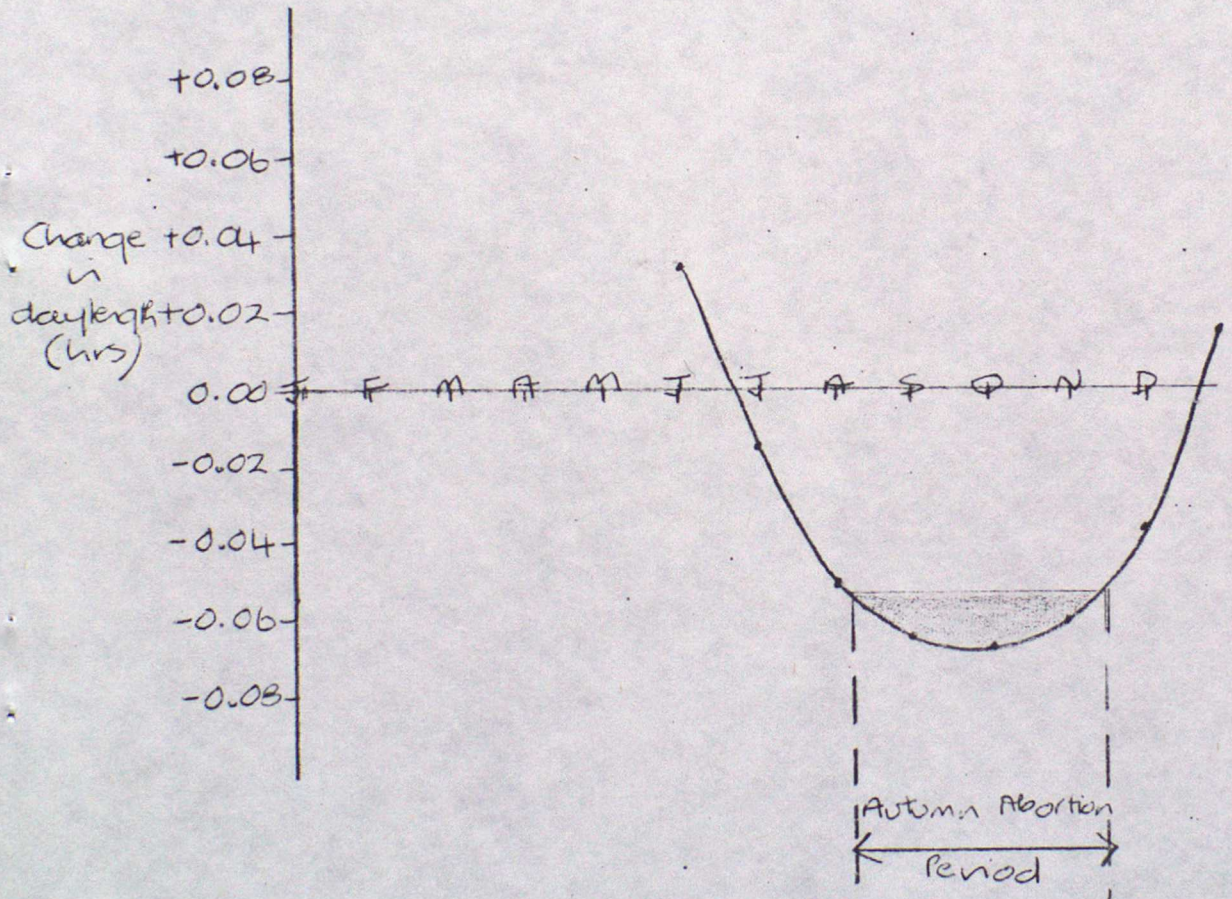

MONDAY 12 NOV NIGHT TUESDAY 13 NOV NIGHT WEDNESDAY 14 NOV NIGHT THURSDAY 15 NOV NIGHT FRIDAY 16 NOV NIGHT SATURDAY 17 NOV NIGHT SUNDAY 18 NOV NIGHT MONDAY
35°C
30°
25°
20°
15°
10°
5°
0°
-5°
-10°
Station Exeter Lat. Long. Ht. ft (M.S.L.) Month Nov Year '79 Time on h m Off h m Marks at h m G.M.T. Sheet No. 7
For use with pen arm 185 mm long. Pen axis 46 mm above flange Scales: 1°C = 1·8 mm. 12 hrs = 20 mm. Size of chart 304 × 90 mm. Margins: Left, 9 mm, Right, Nil. Upper 1·0 mm, Lower 1·0 mm.

Figure 9. Taylor May Abortion data, calculated daylength and change in daylength.





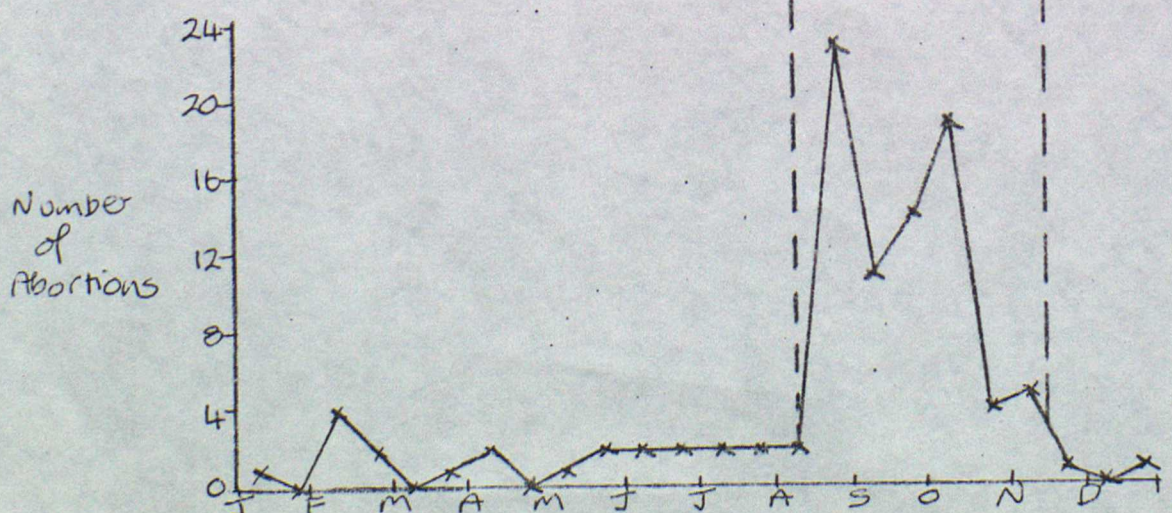


Figure 10. Change in daylength for southernmost and Northernmost farms in this experiment

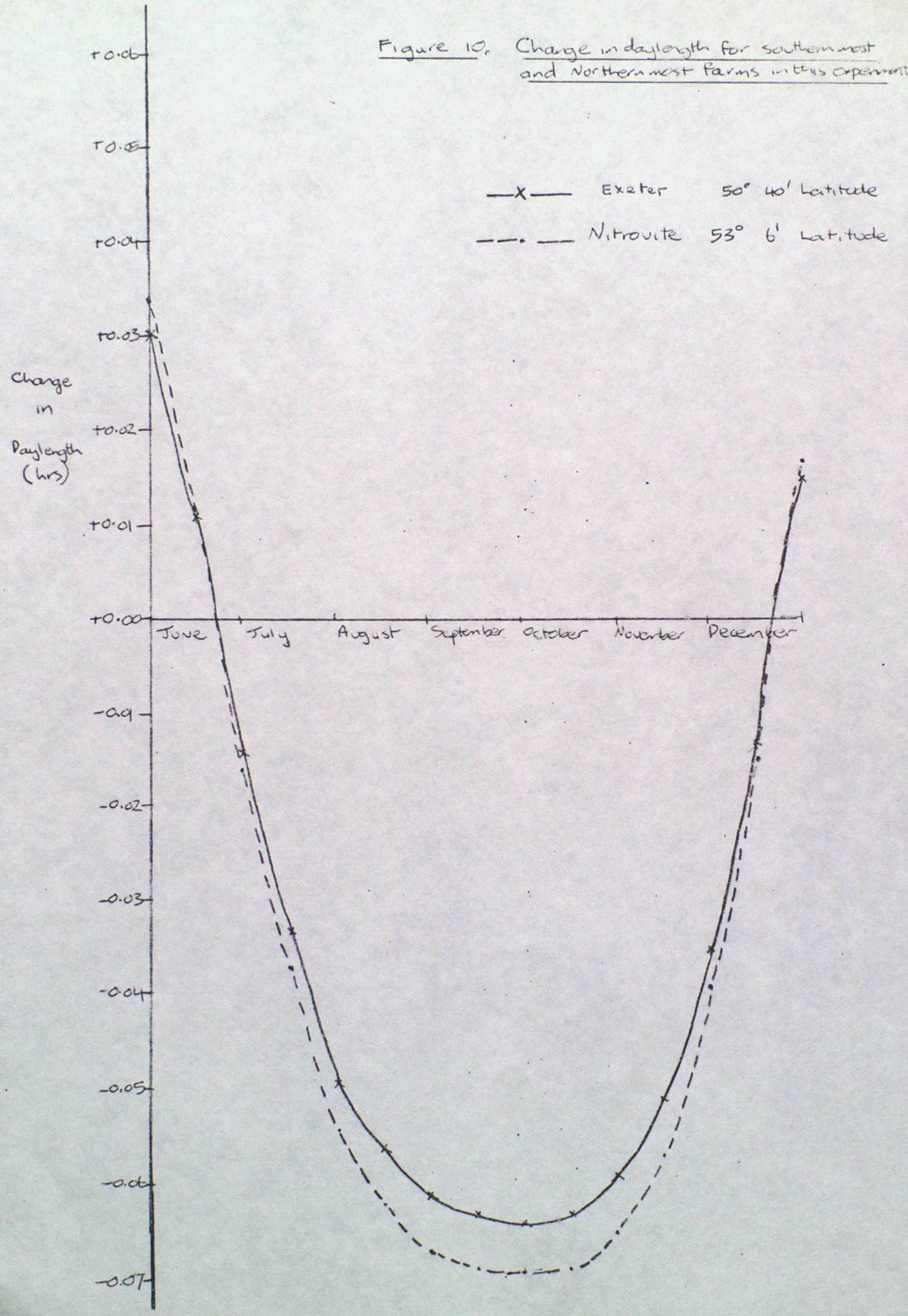


Figure 11 Lee Valley E.H.S., Hoddesden Daily Radiation Values and Taylor May Abortion Data for 1978.

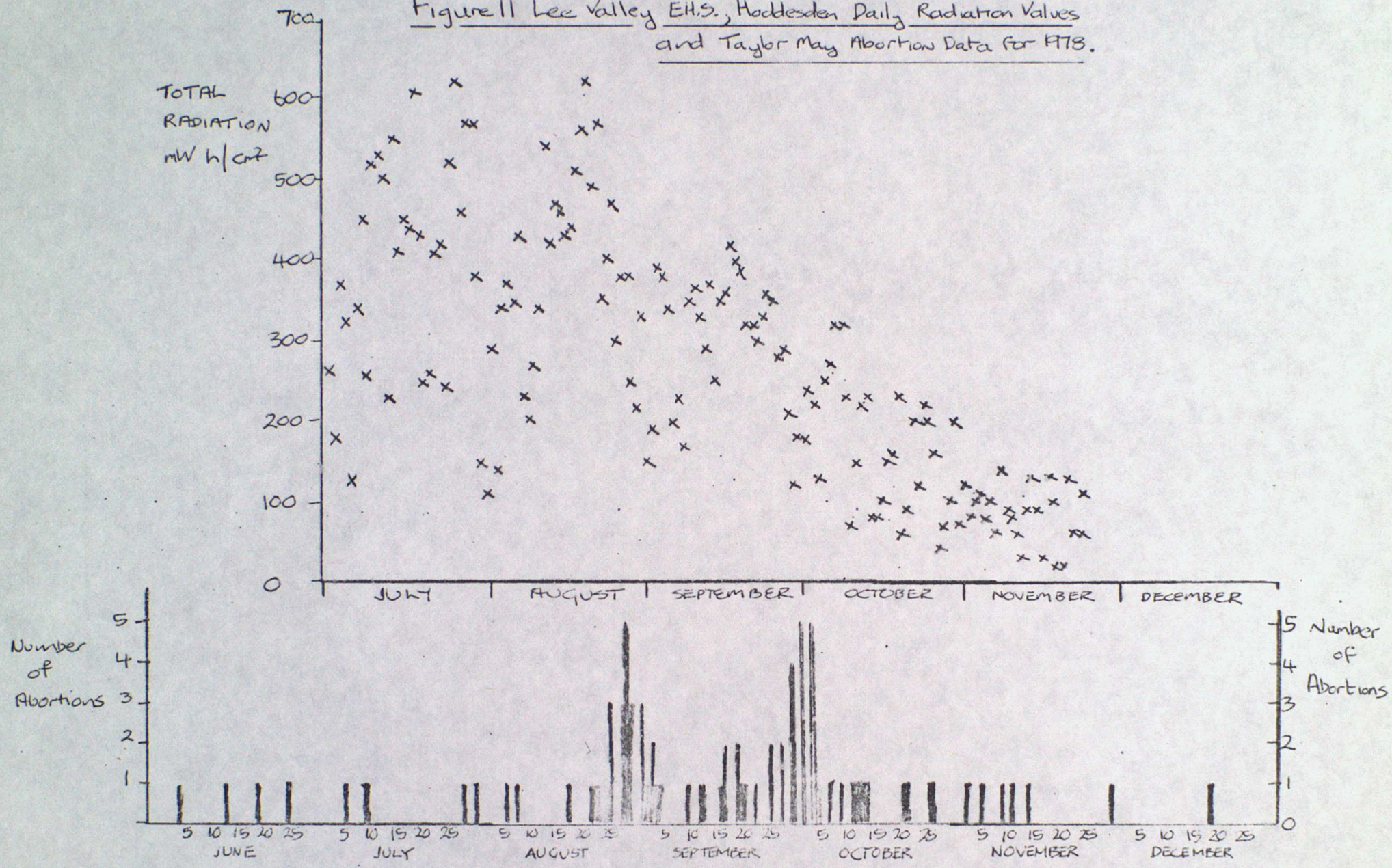
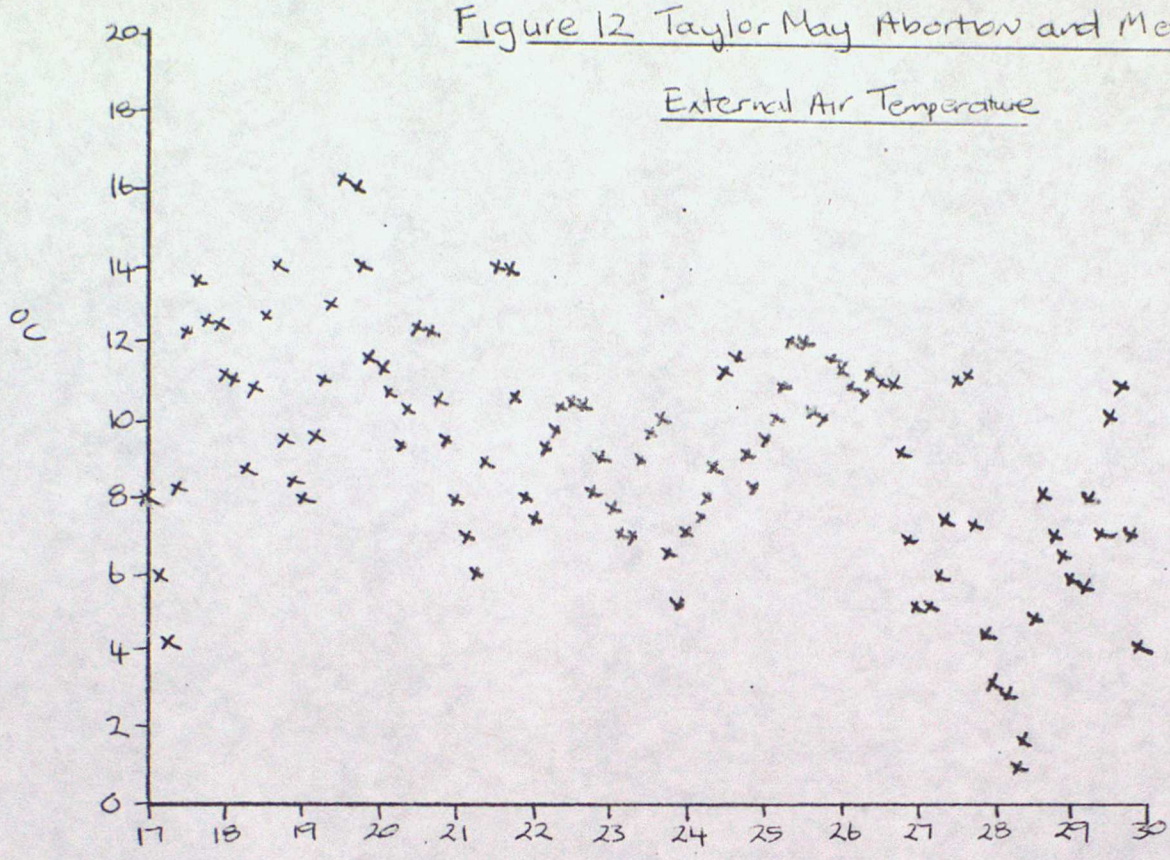
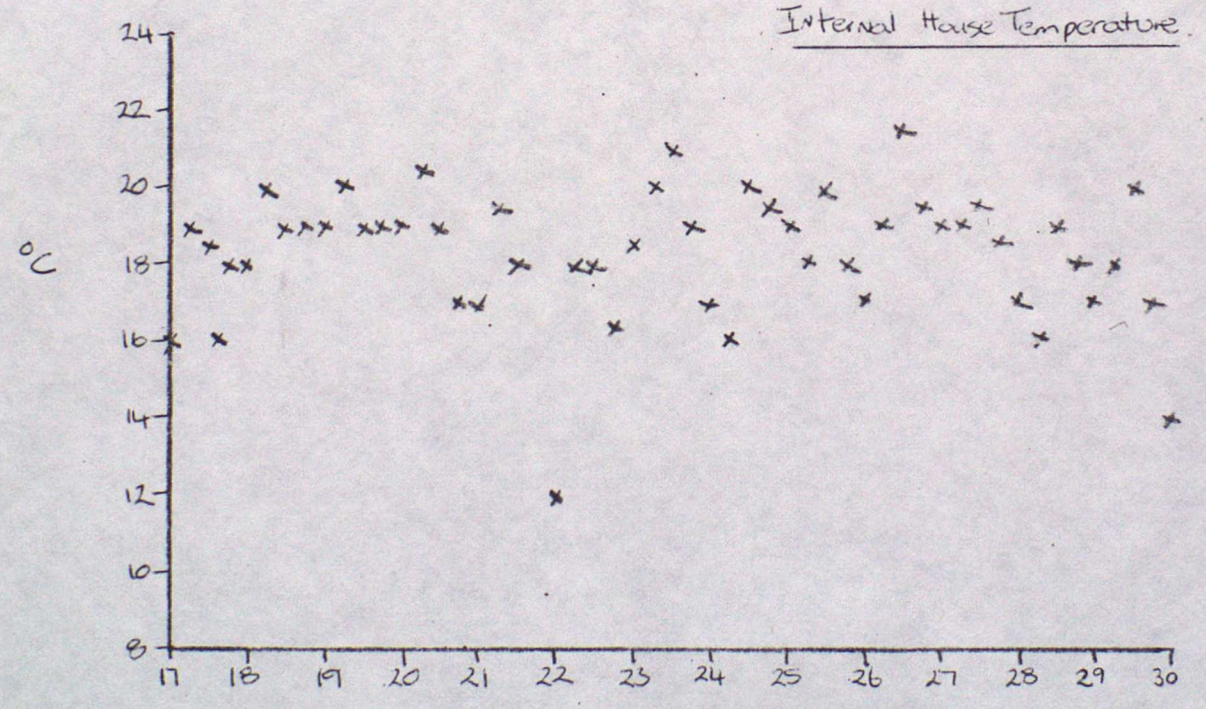


Figure 12 Taylor May Abortion and Meteorological Data.

External Air Temperature



Internal House Temperature



Abortion Data

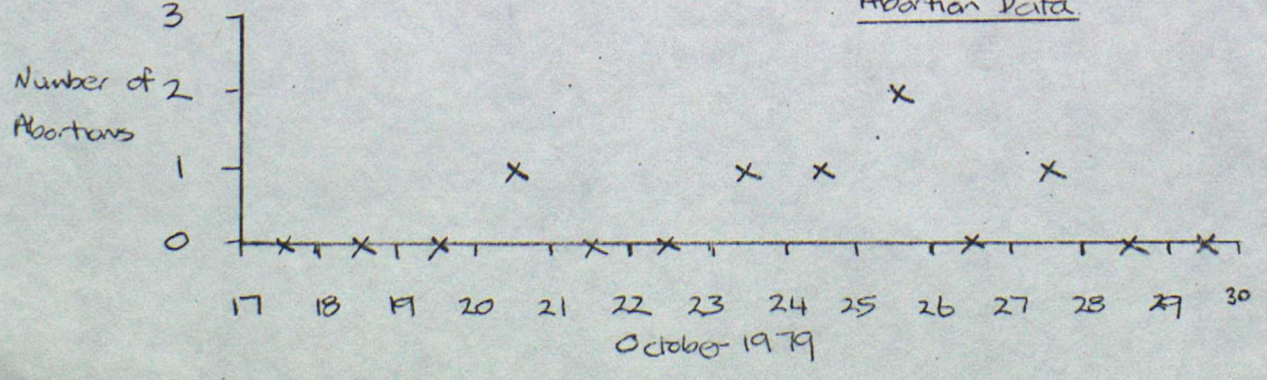
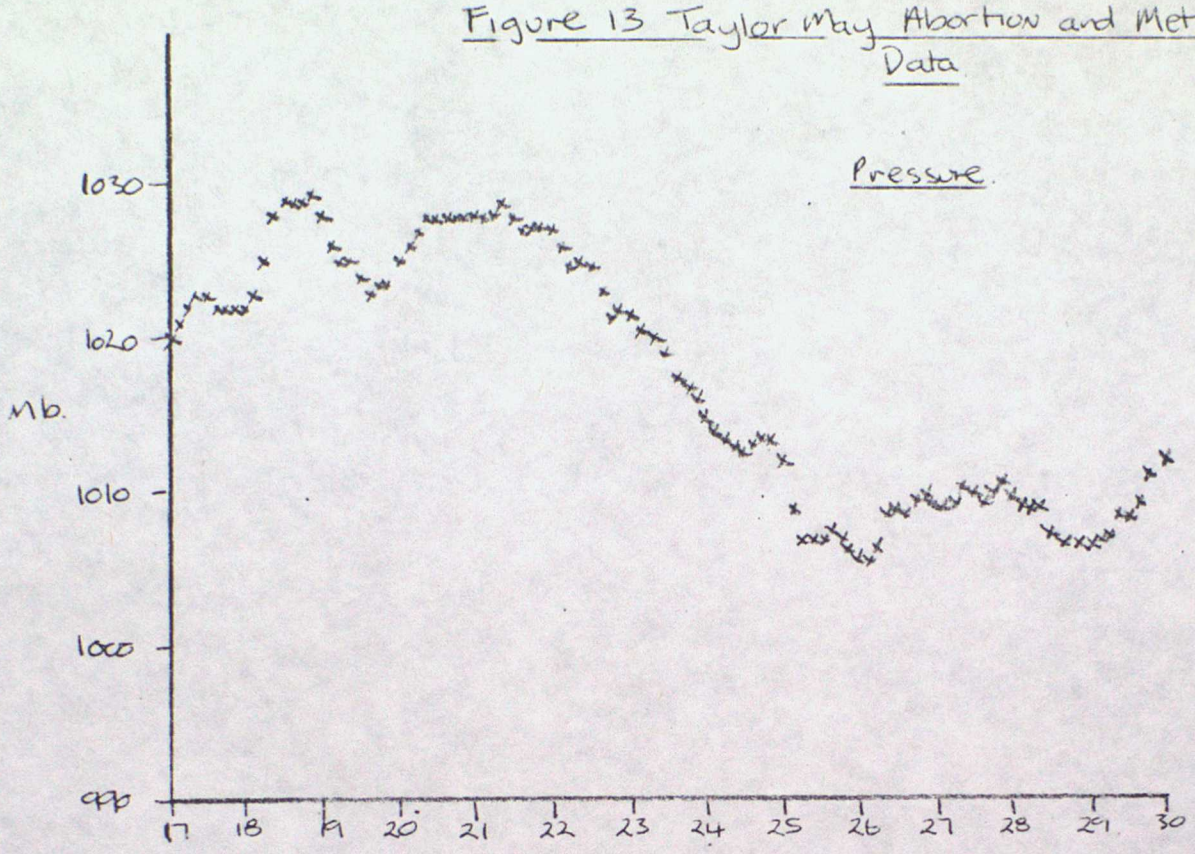
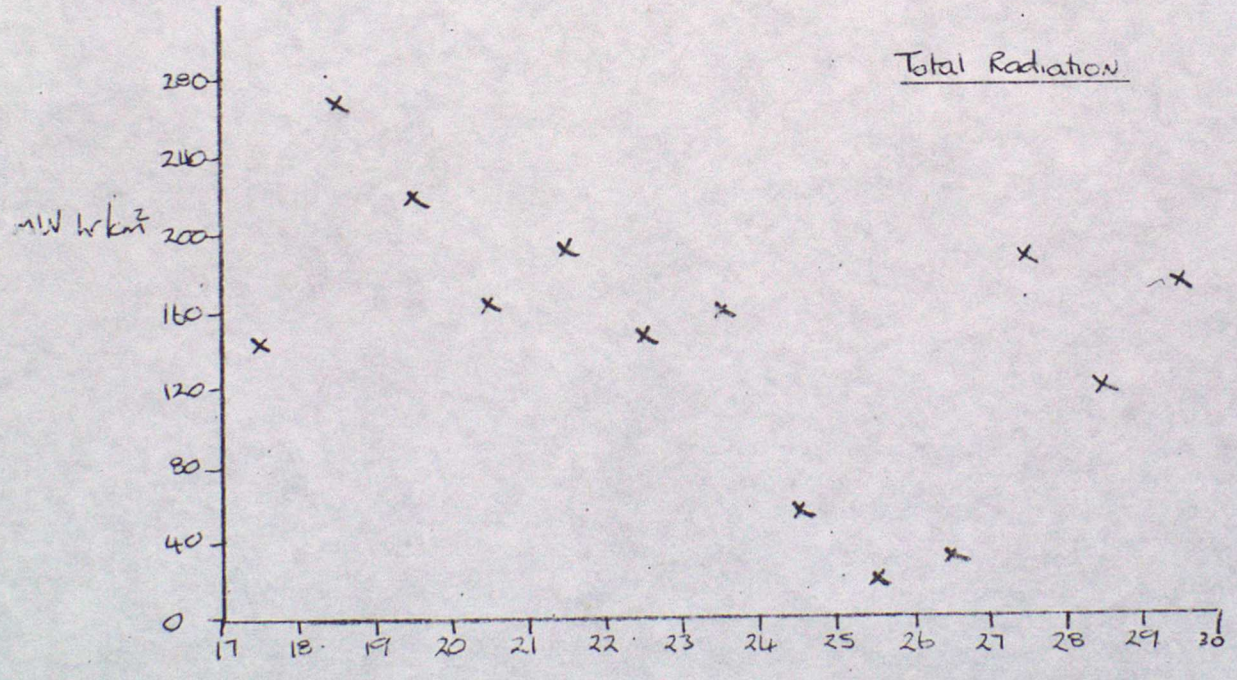


Figure 13 Taylor May Abortion and Meteorological Data





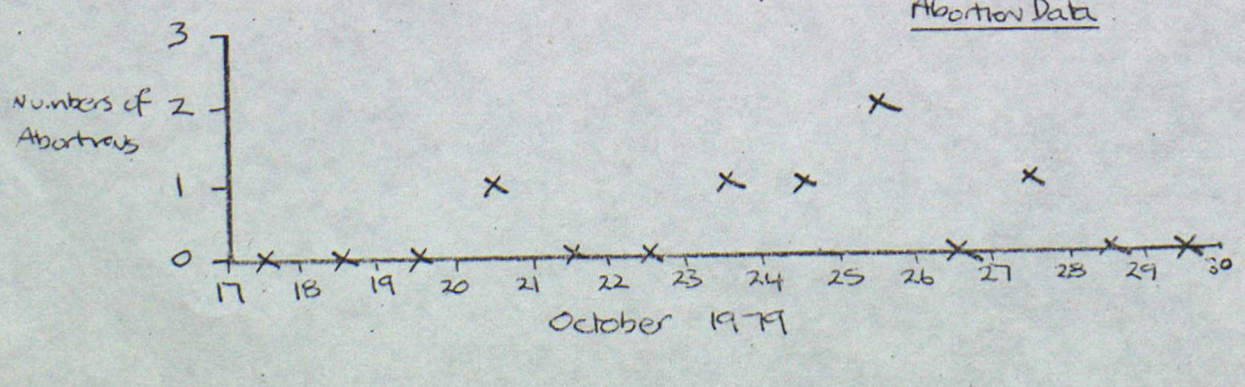


Figure 14 1977 and 1978 Meteorological data applicable to Taylor May Farms

MONTH/YEAR	AIR TEMPERATURE IN DEGREES C								WEATHER (NUMBER OF DAYS)	BRIGHT SUNSHINE	
	MEANS OF		DAILY MEAN (MEAN OF A+B)	DIFFERENCE FROM 1941-70 AVERAGE	HIGHEST MAXIMUM		LOWEST MINIMUM		THUNDER HEARD	DAILY MEAN (HOURS)	PERCENTAGE OF 1941-70 AVERAGE
	MAX. (A)	MIN. (B)			MAX.	DATE	MIN.	DATE			
MARCH/77	10.6	3.5	7.1	+1.4	18.3	2	-3.6	30	0	2.90	80
APRIL/77	11.5	2.9	7.2	-1.4	17.1	22	-5.2	10	2	4.45	83
MAY/77	15.6	6.0	10.8	-0.8	22.1	26/28	0.0	1	2	6.34	99
JUNE/77	17.1	8.0	12.5	-2.2	25.3	13	2.0	9	3	4.1	60
JULY/77	21.3	11.0	16.1	-0.4	27.3	6	5.4	16	0	5.9	97
AUGUST/77	20.1	10.8	15.5	-0.7	26.8	2	3.9	29	0	4.39	77
SEPTEMBER/77	18.0	9.3	13.7	-0.5	22.4	11	2.6	14	0	3.97	85
OCTOBER/77	16.2	7.3	11.7	+1.0	19.2	16	0.0	11	1	3.63	106
NOVEMBER/77	9.8	4.2	7.0	+0.5	17.6	10	-1.4	27	0	2.50	131
DECEMBER/77	8.5	4.1	6.3	+2.0	15.2	23	-2.8	3	0	1.27	89
MARCH/78	10.7	2.7	6.7	+1.0	17.1	11	-3.5	6	0	3.89	107
APRIL/78	10.0	2.7	6.3	-2.3	16.1	24	-3.6	13	0	3.90	73
MAY/78	16.2	6.3	11.3	-0.3	24.8	31	2.6	26	0	6.38	100
JUNE/78	19.0	9.0	14.0	-0.7	26.4	1	1.6	15	0	5.77	84
JULY/78	19.6	10.9	15.3	-1.2	26.2	28	2.9	7	0	4.42	73
AUGUST/78	20.0	10.2	15.1	-1.1	25.0	20	5.0	27,31	-	5.62	99
SEPTEMBER/78	19.2	10.2	14.7	+0.5	25.0	10	2.5	26	0	5.53	118
OCTOBER/78	16.3	6.8	11.5	+0.8	24.9	11	1.4	18,23	0	3.42	100
NOVEMBER/78	11.8	5.3	8.5	+2.0	17.3	2	-7.4	30	0	2.75	144
DECEMBER/78	7.0	1.6	4.3	0.0	14.1	10	-8.2	1	0	1.03	72